Student Perceptions of the Profession and the Decision to Major in Economics

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In Australia, as elsewhere, there has been a dramatic decline in the number of students undertaking undergraduate economics degrees during the 1990s. This applies equally to both specialised economics degree programs and more broadly based economics majors in business degrees. For example, and in terms of specialised economics degrees, Millmow (1995) used a Department of Education, Training and Youth Affairs (DETYA) survey of ten universities to conclude that the aggregate number of students enrolled fell by some 30 percent between 1991 and 1994. However, these official statistics only included students enrolled in the 'Bachelor of Economics', rather than all degree programs which could be reasonably classified as an economics qualification.

Recognising this deficiency, Lewis and Norris (1997) surveyed 35 of Australia's 38 universities and obtained data on the more than one hundred degree programs encompassing economics qualifications. On this basis, they concluded that the fall in total enrolments over the period 1991 to 1996 was closer to 12 percent. In fact, Lewis and Norris (1997) found that total full time equivalent student units (EFTSU) in economics had remained constant for much of the decade, though primarily because the decline in economics qualifications had been off-set by an increase in the number of students undertaking economics units for non-economics programs. Alvey and Smith noted similar trends in New Zealand (1991). These figures are then more comparable to the decline in the number of undergraduate economics degrees experienced in the United States. For instance, Siegfried (1995) documented a fall of 12 percent in 1993 and 9 percent in 1994, while Siegfried (2000: 296) commented inter alia on "…the precipitous 30 percent drop in degrees awarded from 1990-91 through 1995-96".

Irrespective of these differences in measuring participation in economics programs, the fact remains that first-year enrolment in Australian economics degrees and majors declined by more than 12 percent over the 1990s, while enrolments in all business-related degrees (including business, administration and economics) rose by more than 40 percent (DETYA 2000). Importantly, the relatively modest national decrease is not evenly distributed across States or between universities within States (Lewis and Norris 1997). For example, while enrolments in the two most populous states of New South Wales and Victoria experienced moderate falls, enrolments in the four remaining states fell by at least 30 percent and as much as 50 percent. And to some extent, only the lowering of the tertiary entrance score for admission has arrested this decline in enrolments. Lewis and Norris (1997: 4) conclude:

A few universities have always had a high degree of excess demand and low quotas, which means they have not had to reduce their tertiary entrance score. However, most universities have experienced a consistent downward trend in entrance scores…This has allowed most established universities and the new universities to keep their new entrants figure at a reasonably constant level.

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The impact of this decline in the quantity and quality of economics enrolments on academic staffing, the progression of students into postgraduate offerings, and the reorientation of teaching resources to 'service teaching' requires no further comment.

A number of reasons have been given for the declining popularity of economics degrees/majors in Australia. Foremost amongst these is the massive fall in the number of secondary school students taking economics and the rising popularity of business study programs in management, marketing, human resource management and finance. Both of these reasons encompass the perception that these subjects are more interesting and vocationally orientated than economics. Unfortunately, little empirical evidence exists concerning how these and other factors actually affect the choice of individual students to major in economics. For example, while studies of aggregated data concerning the composition of economics cohorts are increasingly commonplace, relatively few studies have directly modelled the choice of a major in economics over closely related alternatives. And almost without exception, this literature has an exclusively North American focus. Furthermore, as far as the authors are aware, no study to date has jointly examined the role of student characteristics and perceptions of the economics profession as key factors in the choice of an economics major.

Accordingly, the purpose of the present paper is to investigate the role of both student characteristics and perceptions in determining the rate of participation in Australian economics majors. The paper itself is divided into four main areas. The second section briefly surveys the empirical literature concerning factors influencing a student's choice of an economics major. The third section explains the empirical methodology and data collection employed in the present analysis. The results are dealt with in the fourth section. The paper ends with some brief concluding remarks.

FACTORS EXPLAINING THE DECLINE IN THE ECONOMICS MAJOR

In contrast to many other disciplinary areas, hypotheses to explain the choice of an economics major are relatively underdeveloped. However, several specific themes have been put forward to explain the decline in the number of economics undergraduate degrees in the 1990s, and these form a suitable basis for examining those hypotheses that have received attention. To start with, a recurrent theme in the economics literature "…is that the recent cycle in the number of undergraduate degrees in economics is connected with changes in the popularity of undergraduate business studies" (Salemi and Eubanks 1996: 324). Salemi and Eubanks (1996), for example, account for the rise and fall in the number of economics majors with a 'discouraged-business-major' hypothesis. They argue that students who were screened out of the undergraduate business program account disproportionately for the increase in economics majors in the 1980s and for the subsequent decrease in the 1990s (Salemi and Eubanks 1996). Willis and Pieper (1996) also link the decline in economics majors with the changes in the popularity of undergraduate business studies. Willis and Pieper (1996) found that schools offering undergraduate business degrees have only one-fourth as many economics majors as schools which do not, and that the offering of a business economics major within the school further lowers the number of economics majors by one-half. Willis and Pieper (1996: 345) concluded, "the largest single factor explaining the number of economics majors in a cross-section was the presence of a competing degree in business".

Brasfield et al. (1996: 363) further examine the interaction between business studies and economics with the suggestion that "…the study of economics may be a market substitute for

a business degree at those institutions that do not offer a degree in business and a complement at those institutions that do offer a business degree". Brasfield et al. (1996) identified two competing hypotheses. First, "…economics departments located at schools offering business degrees may benefit in terms of majors as a result of business student spillover (Brasfield et al 1996: 363). And second, "if economics programs are viewed as a less-desirable substitute for business degrees by business-orientated students, economics programs that compete with in-house business programs may be less at risk…because these programs do not depend on business-orientated students for enrolments" (Brasfield et al 1996: 363). On the basis of a survey of economics departments, they reasoned that flexibility in economics electives appeared to have a positive impact on the attractiveness of a major, and that schools which did not offer an undergraduate business degree were more likely to lose economics majors than schools that did (Brasfield et al 1996).

An alternative approach to this question is taken up in Lewis and Norris' (1997) survey of heads of Australian economics departments. To ascertain their views, a list of eleven possible causes of the decline in economics majors was drawn up. The most important factors identified in this survey all related to the relative position of economics majors to business majors in terms of career focus, the degree of rigour or abstraction, the extent of preparation in mathematics, and overall interest. Lewis and Norris (1997: 12) summarised their analysis as follows: "The reasons for declining enrolments are not fully understood but there is a general perception that the study of economics, at least in terms of specialising in economics, is regarded less favourably compared to business or some unrelated disciplines".

A second theme that has received some attention in the literature is that the decline in economics majors is connected to some long run educational or business cycle. Margo and Siegfried (1996), for example, present evidence to suggest that between 1948 and 1993 economics share of US bachelor degrees averaged 2.2 percent and completed three full cycles. On this basis, they concluded that economics' share of bachelor degrees is a stable process that adjusts only slowly, and that it may take until 2000 for the share to rise from its 1993 low of 1.8 percent to the long-run trend. On the other hand, Willis and Pieper (1996) show that economics' share of degrees follows a very similar path to the (declining) employment pattern in the financial services industry, while Margo and Siegfried (1996) found that the share of economics degrees moves slightly counter to the overall business cycle. Similarly, there is already much evidence suggesting a close linkage between graduate career conditions and the demand for economics majors as against closely related fields. For instance, Lewis and Norris (1997) found that the proportion of economics graduates finding full-time employment in Australia was significantly lower than accounting and business studies.

A third theme in the economics major literature is based on the almost universal observation that "female undergraduates are less likely to take an introductory economics class, to continue in economics after completing the first introductory course, and to major in economics than are male undergraduates" (Jensen and Owen 2000: 466). And while much has been made of the broader 'hard science', 'soft science' division between males and females, even when compared to other business disciplines, female participation in economics majors is relatively low. For example, Bauer and Dahlquist (1999) cite the female percentage of graduating US bachelor's degrees in 1994/95 as 30.8 percent for economics, 33.3 percent for finance, 56.2 percent for accounting, 49.1 percent for international business and 46.8 percent for marketing.

However, while these gender differences are well documented, the underlying reasons for the purported gender bias in economics education are not. Several competing hypothesises have been proposed, and duly tested in the literature. These include suggestions that the economics curriculum, along with the pedagogy and types of evaluation instruments, includes topics and methodology of less interest to women, and that the evaluation favours male learning styles (Horvath *et al*. 1992; Ferber 1995; Nelson 1995; Bartlett 1995; Anderson and Siegfried 1997). Haslehurst et al (1998) identify the importance of these issues "if more women than men hold the view that the subject matter is irrelevant and uninteresting, do we need to consider seriously the feminist critique that the overall orientation of the discipline is too masculine"? The gender bias literature also includes suggestions that female students are relatively poorly prepared for introductory economics in terms of maths preparation, and concomitantly have a lower average performance in economics classes than their male counterparts. It is argued that this is then translated into a lower level of interest in the subject matter itself, with a resultant fall in continuations in economics subjects.

Several studies have examined the role of student gender in participation in economics majors. Dynan and Rouse (1997: 353), for example, examined three dimensions of gender bias in a survey of introductory economics students at Harvard University:

One of the most common hypotheses about why women are less likely to major in economics than men is that women are less proficient or less comfortable using the math needed to do economics…Perceived aptitude for economics may also influence the choice of major because students are presumably more likely to choose a subject in which they expect to do well…another determinant of a student's choice of major might be the presence or absence of role models.

Three sets of variables were collected to help assess these hypotheses. The first hypothesis relied upon students' declaring their math SAT scores and giving an indication of their skill at interpreting graphs. The second drew upon the notion that students focused on relative, as against absolute, performance in economics in order to decide their choice of major. This was indicated by whether or not their performance in introductory economics was better, worse or about the same as their performance in all other courses. Finally, the sex of each student's instructor and the number of females in each section was included to take account of academic and peer role models respectively.

However, after controlling for a number of other factors, Dynan and Rouse (1997) found that only maths background accounted for a limited part of the gender difference in the decision to major in economics, and that while women generally had a lower relative performance in economics, controlling for this factor likewise diminished the gender gap in the choice of economics as a major. The proxies for instructional environment explained little of the gender gap. In explaining their results, Dynan and Rouse (1997: 365) concluded that several factors not taken into account in their analysis may explain the remaining gender gap:

This gap may arise from differences in tastes or other unmeasured characteristics such as knowledge about the nature of economics upon entering college…Women may arrive at college with preconceptions about the nature of the field, having already decided not to major in it.

Jensen and Owen (2000) also examined the role of gender bias in progression in economics with an analysis of economics students across thirty-four US liberal arts colleges. A large number of factors were examined, including grade point average and expected grade, math

SAT scores, and interest in economics careers and entrance into graduate school. Jensen and Owen's (2000: 469) results indicated, "student characteristics and attitudes…are important determinants of the decision to continue to study economics. We find that some factors affect male and female students equally; others have different effects on men and women". However, using an alternative approach to the question of gender bias in ongoing economics participation Chizmar (2000: 116) found that "…after controlling for economics and economics credit hours, the hazard profiles [in terms of discontinuing study] of female economics majors are indistinguishable from their male counterparts".

A study by Dawson-Threat and Huba (1996) gives further appreciation of the difficulty of incorporating gender bias as a factor in the choice of major generally. In this study, gender bias is reflected by the interaction between student gender, whether the major is male or female-dominated, and each student's sex-role identification. When choosing a major, some students may respond more to issues related to their biological self (i.e. their gender), while others place more emphasis on their psychological self (i.e. their sex-role identity). In other words, the choice of major may depend on both societal views of male and female roles and on the sense of comfort for students that results from being with individuals who have similar views of sex roles, whether masculine identified, feminine identified, androgynous or undifferentiated. These final factors in themselves may be sufficient to enable students to 'crossover' into non-traditional majors. Importantly, the study found that the vast majority of females still selected traditional majors for women, irrespective of their own sex-role identification. Dawson-Threat and Huba (1996) suggested that this might be because these students perceived that the female-dominated professions offered more viable options than those that were male-dominated.

When examining existing research on characteristics associated with student choice of a major in economics, a number of salient points emerge. First, relatively little attention has been paid in economics to models explaining a student's choice of a major, and the evidence that does exist has frequently been extracted from university level data. For example, Brasfield et al (1996), Salemi and Eubanks (1996), Willis and Pieper (1996) Lewis and Norris (1997) and Siegfried (2000), amongst others, comment on the choice of an economics major from this perspective. More particularly, quite apart from the standard problems of aggregation and the fact that economic models of consumer choice are only theoretically sound at the individual level, the primary focus of studies of this type is invariably on measurable predictions for individual behaviour. These considerations suggest that future research in this area should be based on individual or micro-level data.

Second, and in contrast to several other disciplines, relatively little attention in economics been paid to measuring what appear to be relatively important factors in the choice of an economics major, that is, student personality and perceptions of, and interest in, the economics profession itself. For example, while some studies have used gender, grade point average, and past studies in economics, amongst others, to proxy interest, very few have concerned themselves directly with how these factors affect student's choice of major. Jensen and Owen (2000: 469), for example, argue "both student characteristics and attitudes that exist prior to setting foot inside an economics class and those that are formed during the class are important determinants of the decision to continue to study economics".

Harvey-Beavis and Elsworth (1998: xix) also found evidence concerning the role of interest in the choice of major, "the demand for tertiary education courses seems to be driven by interests. No evidence was found…to support a contention that pursuit of status or the use of

a ‘cost-benefit’ strategy was important in students’ choice”. This is important because any policy designed to shift enrolment patterns will need to recognise that interests remain relatively stable over time, are not amenable to change, and probably weigh heavily in the decisions of most students. Becker (1997: 1366) cogently underlines this argument: “if building enrolment is important, than the previously uninterested students are the ones that must be attracted. We need to understand the selection process in choosing and persisting in courses, as well as in measuring learning”.

Finally, there has generally been little allowance in studies to date for the complex interaction between the choice of a major in economics and one in another business-related field. This is particularly important since one of the most common themes identified in the ‘declining economics major’ literature has been the rise of competing business studies programs and the suggestion that potential economics majors are funnelled into these alternatives. Rigorous empirical analysis would therefore facilitate greater certainty on the empirical status of students’ choice in majors in the context of its close competition. It is with these considerations in mind that the present study is undertaken.

DATA AND MODEL ESTIMATION

The data used in this study is based on three hundred and forty-five first-year students sampled from the more than four thousand students studying for the three-year undergraduate business degree at Australia’s fifth largest university. This award consists of a set of core units in conjunction with elective majors, double majors and extended majors in accountancy, finance, economics, human resource management, international business, management and marketing. The degree’s tertiary entrance score is common to all majors, and students initially matriculate to a nominated major or majors. However, after the first semester students may apply to change major provided that they satisfy the appropriate unit prerequisites and are able to complete the proposed major within the units remaining in the program.

The analytical technique employed in the present study is to specify students’ choice of major as the dependent variable (y) in a regression with student personality, perceptions and other physical and educational characteristics as explanatory variables (x). The nature of the dependent variable indicates discrete dependent variable techniques are appropriate. Accordingly, the following binary probit model is specified:

$$\text{Prob}(y=1) = \int_{-\infty}^{\beta' x} \phi(t)dt = \Phi(\beta' x) \qquad (1)$$

where x comprises a set of student characteristics posited to influence the selection of an economics major, β is a set of parameters to be estimated and the function $\Phi(.)$ indicates the standard normal distribution. The coefficients imputed by the binary probit model provide inferences about the effects of the explanatory variables on the probability of the choice of a particular major. The requisite dataset is composed of three sets of information.

The first set of information relates to the choice of major and comprises the dependent variable in the binary probit model specified in (1). Students are categorised as either: (i) those who have not nominated an economics major, whether as a single or extended major, or as part of a double major (y = 0); and (ii) those who have nominated an economics major as part of their program (y = 1). The first group consists of all students undertaking single or

extended majors in accountancy, finance, human resource management, international business, management and marketing, excluding double major students combining studies in these areas with a major in economics. Three hundred and fourteen students, or ninety-one percent of cases are categorised as non-economics majors. The second group consists of students undertaking at least one major in economics. Thirty-one students, or some nine percent of cases, are identified as economics majors.

The next two sets of information are specified as explanatory variables in the binary probit regression model. The first of these sets of information relates to several student characteristics derived by survey. Information collected includes a personality score and perceptions of the economics profession along a range of criteria. First, much research suggests that students select majors that are seen as compatible with particular personality styles (Saemann and Crooker 1999: 2). Booth and Winzar (1993), for example, showed that students who were initially attracted to accounting displayed personality traits that led them to prefer learning facts and rules applied in concrete ways, and other studies, such as Wolk and Cates (1994) have also linked specific personality traits to particular majors.

Second, empirical evidence also suggests that a more basic issue behind students' choice of major may be their level of interest and perceptions of the profession. Dynan and Rouse (1997), Lewis and Norris (1997) and Jensen and Owen (2000) have identified the importance of interest and perceptions of the profession as factors determining the choice of an economics major, and Easterlin (1995) has identified preferences as the key factor in the generational switch to business studies.

The survey used included two instruments to measure students' inherent creativity and perceptions of the economics profession. The first instrument required students to complete Gough's 30-item Creative Personality Scale (Gough 1979). Possible scores on this simple adjective checklist range between –12 and +18 with a higher score indicating a more creative individual. The specification of the personality variable (*PRS*) is identical to that specified by Saemann and Crooker (1999) in a recent study of the decision to major in accounting. Appendix A lists the adjectives surveyed and the scoring mechanism applied following the survey. No particular *a priori* sign is hypothesised when economics major is regressed against personality score.

The second measure required students to assign ordered preferences on a 5-point scale between thirty-six opposing adjectives on the basis of their perceptions of the economics profession. Saemann and Crooker (1999) surveyed perceptions of the accounting profession using a similar instrument. These items are arrayed along four dimensions of perceptions relating to the economics profession (number of items in brackets); namely, interest (*INT*) (5), the level of individuality (*IND*) (4), precision or thoroughness (*PRE*) (13) and structure or rule-orientation (*STR*) (14). The pairings for 'interest' include boring vs. interesting, dull vs. exciting and monotonous vs. fascinating, while for 'individuality' they embrace solitary vs. people-orientated and introvert vs. extrovert. These terms are thought to capture student's overall perceptions of the profession and the relationships of persons working within the profession.

The items for 'structure' relate to students' perceptions of the way in which economists deal with problems and tasks. Pairings include structured vs. flexible and routine vs. unpredictable. Finally, 'precision' is captured by pairings including accurate vs. imprecise, challenging vs. easy and mathematical vs. verbal. These items address students' perceptions

about the nature of the types of problems and their solutions in the economics profession. Appendix B lists the items by dimension and from left to right by increasing strength in each dimension (i.e. less interest to more interest) though in the survey itself these items were randomised by classification and coding.

In order to more accurately examine the underlying patterns of relationships among this large number of variables, and given that the study is primarily concerned with prediction, the items within each dimension are reduced using principal components analysis. The latent root criterion is employed to extract the significant factor scores within each dimension (those with eigenvalues greater than unity). Using this criterion, eleven factor scores are derived from the surveyed items as replacements for the original variables. One factor is selected for the interest dimension, two for individuality, five for precision and three for structure. These account for 56, 67, 59 and 49 percent of cumulative variance within each dimension, respectively. Table 1 provides details on the extracted components, eigenvalues, and percentage of variance and cumulative percentage of variance for these factor scores.

TABLE 1
Total Variance Explained by Extracted Principal Components

Variable set	Component	Eigenvalue	Percentage of variance	Cumulative percentage of variance
Interest (5)	INT1	2.747	56.123	56.123
Individuality (4)	IND1	1.464	39.743	39.743
	IND2	1.010	27.405	67.148
Precision (14)	PRE1	2.755	20.807	20.807
	PRE2	1.538	11.614	32.421
	PRE3	1.428	10.787	43.207
	PRE4	1.096	8.279	51.486
	PRE5	1.010	7.626	59.113
Structure (13)	STR1	3.809	30.625	30.625
	STR2	1.327	10.667	41.292
	STR3	1.004	8.073	49.365

Notes: The number of principal components extracted from each set of questions is determined by the latent root criterion where only components having eigenvalues greater than unity are considered significant. The numbers of original variables for each dimension are in brackets.

The hypothesis underlying the factor score for interest (*INT*) follows the suggestion that students interested in a particular profession are more likely to select a major in that area. A positive coefficient is hypothesised when economics major is regressed against interest. The three remaining sets of factor scores relate to the contention that many non-economics major students generally perceive economics as an individualistic (*IND*), excessively mathematically precise (*PRE*) and highly structured (*STR*) subject, and these are posited to act against the selection of an economics major. Siegred *et al*. (1991), Becker (1997) and Salemi and Siegfried (1999), amongst others, have commented in depth on the goals of economics education and the realities of the economics major in this regard. Conceptually speaking, the factor scores specified as explanatory variables represent the degree to which each student scores high on the group of items that load high on the factor. Thus, students who score high on the several variables that have heavy loadings on the factor will obtain a high factor score on that factor. Thus the factor scores for interest, individuality, precision and structure can be interpreted as composite measures within each dimension, and therefore the *ex ante* signs on the estimated coefficients will be identical to that hypothesised for the

original raw data. Negative coefficients are hypothesised when economics major is regressed against *IND*, *PRE* and *STR*.

The final set of information includes recorded student characteristics that are cross tabulated with the survey data. Selected descriptive statistics are detailed in Table 2. Characteristics recorded include each student's sex, secondary school studies, grade point average to date and attendance mode. The first variable specified is a qualitative variable indicating whether the student is female (*SEX*) (192 cases or 55.65 percent of the sample). There is generally strong evidence to suggest that female undergraduates are less likely to take an introductory economics class, to continue in economics after completing the first introductory course, and to major in economics than are male undergraduates.

For example, Dynan and Rouse (1997: 358) used descriptive statistics to indicate that female economics students generally received lower grades, had lower levels of mathematical preparation, had more difficulty in interpreting graphs, felt less comfortable asking questions in class and were generally less-interested in the subject matter than males. A regression of the decision to major in economics against gender indicated that "…women were 7.7 percentage points less likely to major in economics than men, a difference that was statistically significant at the 5 percent level". Conversely, Chizmar (2000) concluded, "the evidence suggests that, after controlling for relative grades in economics and economics credit hours, the hazard profiles of female economics majors are indistinguishable from their male counterparts". Nevertheless, a negative sign is hypothesised when economics major is regressed against student gender.

TABLE 2
Descriptive Statistics for Explanatory Variables

	Description	Variable	Non-economics majors		Economics majors	
			Mean	Standard deviation	Mean	Standard deviation
Personality and perception characteristics	Personality score	PRS	1.8662	3.2422	3.2258	2.8833
	Interest factor score (1)	INT1	-0.0731	0.9783	0.7412	0.9249
	Individuality factor score (1)	IND1	0.0249	1.0047	-0.2527	0.9281
	Individuality factor score (2)	IND2	-0.0089	0.9932	0.0908	1.0788
	Precision factor score (1)	PRE1	0.0085	0.9908	-0.0868	1.1023
	Precision factor score (2)	PRE2	-0.0480	0.9996	0.4868	0.8781
	Precision factor score (3)	PRE3	0.0142	1.0174	-0.1444	0.8010
	Precision factor score (4)	PRE4	-0.0221	0.9896	0.2248	1.0915
	Precision factor score (5)	PRE5	0.0009	0.9987	-0.0092	1.0295
	Structure factor score (1)	STR1	0.0270	0.9948	-0.2742	1.0272
	Structure factor score (2)	STR2	-0.0260	0.9988	0.2640	0.9886
	Structure factor score (3)	STR3	-0.0215	1.0134	0.2179	0.8343
Other characteristics	Female	SEX	0.5732	0.4953	0.3870	0.4951
	Secondary accounting studies	ACC	0.5095	0.5007	0.2580	0.4448
	Secondary business studies	BUS	0.1305	0.3374	0.1612	0.3738
	Secondary economics studies	ECO	0.3694	0.4834	0.4516	0.5058
	Part-time attendance	ATT	0.1656	0.3723	0.1612	0.3738
	Grade point average	GPA	4.6227	0.9531	4.2948	1.0112

The second set of student characteristics specified relate to experiences in secondary education. It is generally acknowledged that secondary school preparation for university study is linked with the choice of an economics major. One dimension of this work relates to mathematical preparation in calculus, especially in regard to the purported gender bias in economics majors. For instance, Dynan and Rouse (1887) included a math SAT score, along

with dummy variables for pre-calculus, first semester calculus, second semester calculus, multivariate calculus, and linear algebra or higher as indicators of student preparation and aptitude for an economics major.

An alternative dimension of this work, especially in Australia, relates to students continuing study in economics first taken up in secondary school. For example, Lewis and Norris' (1997: 9) survey of academic departments reflected a consensus opinion that "school students are taking 'easier' courses such as business studies and legal studies rather than economics" and this was eventually reflected in declining enrolments in economics degrees and majors. Anderson and Johnson (1992) touched upon this argument with an analysis of economics in Australian secondary schools. They found that while the number of students taken secondary-level economics had declined in all Australian states and territories, the decline had been less in those states where "economics has few alterative business-related courses with which to compete".

In order to examine the interaction between studies in business-related disciplines at the secondary level and the choice of an economics major three qualitative variables are specified. These are whether the students undertook elective secondary studies in accounting (ACC) (168 students or 48.70 percent of cases), business studies (BUS) (46 or 13.33 percent of cases) or economics (ECO) (130 or 37.68 percent of cases). As an alterative, Dynan and Rouse (1997: 356) included a number of questions on their survey "designed to shed some light on the role of tastes and, to some extent, knowledge about economics before arriving at university". As business-related studies, all three variables could potentially be associated with an increase in the probability of selecting an economics major if the sample included non-business related disciplines. However, within the narrower context of a business degree it is expected that secondary school studies in accounting and business will be reflected in an increased likelihood of a non-economics major, while studies in secondary economics will be associated with a higher probability of selecting an economics major. The ex ante sign on ACC and BUS is negative, while that for ECO is positive.

The final two variables specified in the analysis relate to additional student characteristics concerned with current attendance and performance. These are whether the student is attending on a part-time basis (*ATT*) (57 cases or 16.52 percent of the sample) and their grade point average to date (*GPA*). To start with, little is known about any systematic difference between a student's attendance pattern and the choice of major. No particular *a priori* sign is hypothesised when the choice of an economics major is regressed against a qualitative variable indicating attendance pattern. And second, a number of studies have hypothesised a link between student performance at the tertiary level and the choice of the (more difficult) economics major. Chizmar (2000) and Dynan and Rouse (1997), for example, included allowance for overall student performance in their studies of persistence and choice of major respectively. A positive coefficient is hypothesised.

EMPIRICAL RESULTS

The estimated coefficients, standard errors and *p*-values of the parameters detailed above are presented in Table 3. To facilitate comparability, marginal effects are also calculated and included in Table 3. These indicate the marginal effect of each outcome on the probability of the choice of an economics major. In order to provide the marginal effects for the continuous variables, the standard normal density function is used with the index predictions evaluated at the sample means. Also included in Table 3 are statistics for joint hypothesis and likelihood ratio (LR) tests, the McFadden

R^2 as an analogue for that used in the linear regression model, and a Hannan-Quinn (HQ) model specification criterion. Four separate models are estimated. The estimated coefficients and standard errors employing the entire set of student personality, perceptions and other characteristics are shown in Table 3 columns 1 to 4. The results of estimations using first, the set of personality and perception variables and then the set of other characteristics alone are detailed in columns 5 to 8 and 9 to 12 respectively. A final specification incorporating selected variables from both of these sets of characteristics and personality and perceptions is detailed in columns 13 to 16.

The estimated models are all highly significant, with likelihood ratio tests of the hypothesis that all of the slope coefficients are zero rejected at the .05 level or lower using the chi-square statistic. The results in these models also appear sensible in terms of both the precision of the estimates and the signs on the coefficients. In the full specification, the estimated coefficients for personality (*PRS*), interest (*INT1*), precision (*PRE2*), accounting (*ACC*) and grade point average (*GPA*) are significant and conform to *a priori* expectations. The estimated coefficients indicate that students with a higher personality score or with a higher level of interest in the economics profession are more likely to select an economics major, while those that perceive the profession as being precise or who have completed studies in accounting at secondary school are less likely to select an economics major. The two largest marginal effects on the decision to undertake an economics major are interest in the economics profession (6.8 percent) and past studies in accounting (-7.4 percent).

These results are generally consistent with the estimated coefficients in the second regression where only the set of personality and perception characteristics are included. However, they differ to the results in the third regression where the model is re-estimated with only the set of other student characteristics. In the third regression past studies in business (*BUS*) and economics (*ECO*) are significant, along with part-time attendance (*ATT*). An incremental contribution of variables *F*-test is employed to reject the null hypotheses that the economics major model could be estimated on the basis of the nested 'no other characteristic effect' [F = 4.2617] and 'no personality/perception effect' [F = 5.2709] models at the .01 level, and we may conclude that students' choice of an economics major is a function of both student personalty and perceptions of the economics profession, along with the more readily observed student characteristics such as past secondary studies, GPA, gender and attendance pattern.

In order to further refine the overall specification, F tests were used to test combinations of coefficients for redundancy and on this basis the variables for *IND* (F = 1.2276, p-value = 0.2943), *PRE* (F = 0.8391, p-value = 0.52268), *STR* (F = 1.6114, p-value = 0.1865), *ATT* and *GPA* (F = 1.1669, p-value = 0.9999) were excluded from the final specification. Each of the remaining variables was tested in a similar manner, though they failed to be excluded from the final specification. The refined model is presented in columns 13 to 16 of Table 3. The likelihood ratio for the refined model is significant at the 1 percent level of significance, and we may conclude that the explanatory variables as a group can be used to investigate the choice of an economics major. While the R^2 of the final specification (0.1655) is lower than that of the full specification (0.2185) the Hannan-Quinn criteria, reflecting the trade-off between goodness of fit and model complexity, indicates that the final specification is more appropriate (a lower HQ value).

It would appear from the final specification that the primary influence the selection of a major in economics is personality, level of interest in the profession and past studies in accounting. Of these variables, the most significant marginal effect on a choice of an economics major occurs with past studies in accounting. In addition, while several other variables were individually insignificant, including gender and secondary studies in business and economics, they could not be excluded from the model under any conventional criteria.

TABLE 3
Binary Probit Model Maximum-Likelihood Estimates

Variable	Full specification				No other characteristic effect				No personality/perception effect				Final specification			
	Estimated coefficient	Standard Error	p-value	Marginal effect	Estimated coefficient	Standard Error	p-value	Marginal effect	Estimated coefficient	Standard Error	p-value	Marginal effect	Estimated coefficient	Standard Error	p-value	Marginal effect
CONS.	-0.6380	0.5726	0.2652		-1.7200	0.1467	0.0000		-0.4418	0.4847	0.3620		-1.5243	0.2051	0.0000	
PRS	0.0576	0.0264	0.0289	0.0074	0.0687	0.0259	0.0082	0.0095					0.0671	0.0272	0.0137	0.0092
INT1	0.5300	0.1564	0.0007	0.0680	0.4765	0.1459	0.0011	0.0660					0.4982	0.1304	0.0001	0.0685
IND1	0.0248	0.1130	0.8264	0.0032	0.0363	0.1217	0.7649	0.0050								
IND2	0.1416	0.1057	0.1804	0.0182	0.1035	0.1009	0.3051	0.0143								
PRE1	-0.0360	0.1452	0.8041	-0.0046	-0.0690	0.1422	0.6237	-0.0097								
PRE2	0.2130	0.1159	0.0661	0.0273	0.2239	0.1128	0.0472	0.0310								
PRE3	-0.0409	0.1063	0.7007	-0.0052	-0.0627	0.1063	0.5551	-0.0087								
PRE4	0.0840	0.0980	0.3913	0.0108	0.1026	0.0901	0.2547	0.0142								
PRE5	-0.0453	0.1078	0.6740	-0.0058	-0.0071	0.1073	0.9466	-0.0010								
STR1	0.1192	0.1516	0.4317	0.0153	0.0878	0.1469	0.5501	0.0122								
STR2	0.0768	0.1029	0.4553	0.0099	0.0682	0.1017	0.5026	0.0094								
STR3	0.0886	0.1054	0.4007	0.0114	0.0946	0.0999	0.3435	0.0131								
SEX	-0.1298	0.2137	0.5437	-0.0166					-0.2898	0.2048	-0.1150	0.1570	-0.1258	0.2035	0.5364	-0.0173
ACC	-0.5781	0.2481	0.0198	-0.0741					-0.5497	0.2143	-0.2180	0.0103	-0.5625	0.2378	0.0180	-0.0773
BUS	0.3119	0.3155	0.3228	0.0400					0.1748	0.2784	0.0693	0.5301	0.4050	0.2971	0.1729	0.0557
ECO	0.2390	0.2394	0.3180	0.0307					0.1809	0.2099	0.0718	0.3888	0.2072	0.2209	0.3483	0.0285
ATT	0.0942	0.2996	0.7531	0.0121					0.0700	0.2643	0.0278	0.7910				
GPA	-0.2110	0.1201	0.0788	-0.0271					-0.1454	0.1069	-0.0577	0.1739				
l	-81.4693				-87.8400				-97.2278				-87.0021			
$l(0)$	-104.2598				-104.2598				-104.2598				-104.2598			
LR	45.5808		0.0003		32.8395		0.0010		14.0638		0.0289		34.5154		0.0000	
HQ	0.6667				0.6422				0.6352				0.5759			
R^2	0.2185				0.1574				0.0674				0.1655			

Notes: l – log-likelihood, $l(0)$ – restricted slopes log-likelihood, LR – likelihood ratio statistic; p-value of LR calculated using $\chi^2(p)$ where p = number of explanatory variables; HQ – Hannan-Quinn criterion; R^2 – McFadden R-squared; marginal effects calculated at means.

Finally, the ability of the various models to accurately predict outcomes in students' choice of major is examined. Table 4 provides the predicted results for each different model specification. The correct and incorrect percentage figures for the estimated models are in terms of the observed (or actual) value of economics and non-economics majors, total percentages for correct and incorrect percentages are in terms of total observations. Comparisons are made with a constant probability model. Observations in the constant probability results are classified using the predicted probability given by the sample proportion of economics and non-economics majors. These probabilities, which are constant across individuals, are the values computed from estimating a model that includes only an intercept term. The absolute gain is the percentage change of correct predictions of the estimated models over the percentage of correct predictions in the constant probability model. The relative gain is the absolute gain as a percentage of the incorrect predictions in the constant probability model. These provide a measure of the predictive ability of the estimated models.

TABLE 4
Observed and Predicted Values for the Binary Probit Models

		Non-economics majors		Economics majors		Total		Hosmer-Lemeshow	
		Number	Percent	Number	Percent	Number	Percent	Statistic	p-value
Constant probability model	Correct	285.79	91.01	2.79	8.99	288.57	83.64	NA	NA
	Incorrect	28.21	8.99	28.21	91.01	56.42	16.36		
	Absolute gain	NA		NA		NA			
	Relative gain	NA		NA		NA			
Full specification	Correct	290.45	92.50	7.35	23.70	297.80	86.32	7.0633	0.5298
	Incorrect	23.55	7.50	23.55	75.97	47.10	13.68		
	Absolute gain	4.66	1.49	4.56	14.71	9.23	2.68		
	Relative gain		16.52		16.16		16.36		
No other characteristic effect	Correct	289.05	92.05	6.15	19.84	295.20	85.57	4.2880	0.8302
	Incorrect	24.95	7.95	24.85	80.16	49.80	14.43		
	Absolute gain	3.26	1.04	3.36	10.86	6.63	1.92		
	Relative gain		11.56		11.91		11.75		
No personality/ perception effect	Correct	286.93	91.38	3.90	12.57	290.83	84.30	16.1578	0.0402
	Incorrect	27.07	8.62	27.10	87.43	54.17	15.70		
	Absolute gain	1.14	0.37	1.11	3.58	2.25	0.65		
	Relative gain		4.04		3.94		4.00		
Final specification	Correct	289.09	92.07	6.12	19.76	295.21	85.57	7.2387	0.5111
	Incorrect	24.91	7.93	24.88	80.24	49.79	14.43		
	Absolute gain	3.30	1.05	3.33	10.77	6.64	1.93		
	Relative gain		11.70		11.85		11.77		

For example, of the 314 students who selected a non-economics major, the full model specification predicted 290.45 cases (92.5%) correctly, and identified 23.55 students (7.5%) as economics majors. This represented an absolute gain of 1.49 percent (increase in correct predictions) and a relative gain of 16.52 percent (improvement over the incorrect predictions) as compared to the constant probability model. For the 31 students who selected an economics major, the model correctly identified 7.35 (23.72%) as economics majors and 23.55 (75.90%) as non-economics majors. Overall, the full specification correctly identified 297.80 (86.32%) as either economics or non-economics majors and incorrectly identified 47.10 students as either economics or non-economics majors (13.68%). This reflected an absolute improvement of 2.68 percent and a relative improvement of 16.36 percent over the constant probability model. The Hosmer-Lemeshow goodness-of-fit test statistic in Table 4 fails to reject the null hypothesis of no misspecification for the full specification.

These results are broadly comparable to the number and percentage of correct predictions for the no other characteristic effect and no personality/perceptions effect specifications. However, the Hosmer-Lemeshow goodness-of-fit test statistic for the model containing excluding student personality and perceptions rejects the null hypothesis of no functional misspecification and we can conclude this model is functionally misspecified. This provides further support for the argument that students' choice of major is very much a functional of individual personality and perceptions about the profession in which they are considering entry. Overall, the models examined successfully predict the major that some 86 percent of students will take, comprised of 92 percent of non-economics majors and up to 23 percent of economics majors. Interestingly, the model that excludes the personality and perception effects scores approximately the same number of correct predictions for non-economics majors as the full and final specification (approximately 92 percent). However, the percentage of correct predictions for economics majors in this model is much worse (12 percent) than either the full or final specification (23 percent and 19 percent respectively). This would suggest that personality and perceptions are a key indicator of the actual choice of an economics major.

These findings would initially suggest that the choice of major model employed might be more useful in identifying non-economics majors than economics majors. And at first impression, the actual number of correct predictions across all majors appears relatively small. However, it should be noted that the amount of variability in the explanatory variables across all majors is also relatively low, given they are related to very closely related disciplines. Put differently, we would expect that perceptions and interest in the economics profession would be much closer for an accounting and economics major than that between economics and a non-business related discipline in the humanities or physical sciences. This would suggest that an equivalent model applied to a sample of economics majors and, say, non-business related majors, would likely yield a higher proportion of correct predictions.

CONCLUDING REMARKS

The present study uses a binary probit model to investigate the role of student personality, perceptions and other characteristics in determining the choice of major for Australian business students. The current paper extends empirical work in this area in at least two ways. First, and as far as the authors are aware, it represents the first attempt to apply qualitative statistical models of choice of major in Australia. The evidence provided suggests that the choice of an economics major is a function (at least in the context of models of this type) of student personality, interest in the economics profession, and non-economics secondary studies, and to a lesser extent, gender.

Second, the study analyses in detail the varying influences of personality/perception and other student characteristics. The results indicate that students' physical and educational characteristics, whilst in themselves useful indicators of a student's choice of major, may be supplemented by factors associated with student personality and perceptions of the profession. On the basis of the explanatory variables specified, the major of some 86 percent of students can be correctly identified. Unfortunately, from a policy perspective the results do more to identify likely non-economics majors, than to present possible ways to increase the likelihood of students selecting a major in economics. For example, the level of student interest in the profession is seen as a major factor in the choice of an economics major. This is important because any policy designed to shift enrolment patterns will need to recognise that interests remain relatively stable over time, are not amenable to change, and probably

weigh heavily in the decisions of most students. Nevertheless, some avenues for increasing interest in the profession are possible, including the promotional activities of professional associations and a more concerted effort to stimulate the interest of students in introductory classes.

Of course, the study does suffer a number of limitations, all of which suggest directions for future research. To start with, while the results of the study are suggestive of policy changes, they are not sufficiently developed to provide an empirically feasible guide to economics departments, and mainly reinforce widely held perceptions of the causes of the recent decline in economics majors. It may be possible that other analytical techniques could be used to predict students' choice of major. For example, some promising advances have been made in the use of neural network models to predict other qualitative outcomes. However, in many cases these have not yet been shown to exhibit any advantage over well-known statistical methods.

A second limitation is that the data used contains no information concerning the large number of other factors likely to impact upon a given student's choice of major. For example, Haslehurst et al. (1998) examined the gender bias in economics with specific questions about expected career financial remuneration, promotional opportunities, career path, compatibility with family commitments and the availability of role models. Rumberger and Thomas (1993) also examined future returns to the choice of college major, while Dynan and Rouse's (1997) study included valuable information on economics students' principal reasons for taking economics and the interaction between students' choice of major and the teaching environment. And in a broader context, Pearson and Dellman-Jenkins (1997) investigated the role of parental influence on a student's selection of a college major.

A final limitation is that studies of students' choice of major need to incorporate more fully economic models of occupational choice. For example, Easterlin (1995) examined the switch to business majors in the 1980s in the context of preferences and the relative returns from alternative occupations. A comparable analysis could potentially be made within alternative business-related disciplines. Regrettably, detailed information of this type was not available.

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APPENDICES

Appendix A: Personality score checklist

_____ clever	_____ capable	_____ cautious^
_____ commonplace^	_____ confident	_____ conservative^
_____ conventional^	_____ dissatisfied^	_____ egotistical
_____ honest^	_____ humorous	_____ individualistic
_____ informal	_____ insightful	_____ intelligent
_____ inventive	_____ mannerly^	_____ narrow interests^
_____ original	_____ pompous^	_____ reflective
_____ resourceful	_____ self-confident	_____ sexy
_____ sincere^	_____ snobbish	_____ submissive^
_____suspicious^	_____ unconventional	_____ wide interests

Appendix B: Perceptions of the economics profession

Individual Interest	Boring	1…5	Interesting
	Dull	1…5	Exciting
	Monotonous	1…5	Fascinating
	Ordinary	1…5	Prestigious
	Tedious	1…5	Absorbing
	Benefits Society	1…5	Profit-Driven
	Extrovert	1…5	Introvert
	People-Oriented	1…5	Number Crunching
	Interaction with Others	1…5	Solitary
Precision	Ambiguity	1…5	Certainty
	Analytical	1…5	Conceptual
	Dynamic	1…5	Stable
	Easy	1…5	Challenging
	Imprecise	1…5	Accurate
	Intuition	1…5	Facts
	Novelty	1…5	Methodical
	Originality	1…5	Conformity
	Overview	1…5	Details
	Spontaneous	1…5	Planned
	Superficial	1…5	Thorough
	Theoretical	1…5	Practical
	Variety	1…5	Repetition
	Verbal	1…5	Mathematical
Structure	Abstract	1…5	Concrete
	Adaptable	1…5	Inflexible
	Alternative Views	1…5	Uniform Standards
	Changing	1…5	Fixed
	Creative Solutions	1…5	Cut & Dry
	Decision Making	1…5	Record Keeping
	Effectiveness	1…5	Efficiency
	Flexible	1…5	Structured
	Imagination	1…5	Logic
	Innovation	1…5	Compliance
	New Ideas	1…5	Established Rules
	New Solutions	1…5	Standard Procedures
	Unpredictable	1…5	Routine